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ABSTRACT

The testing of a number of hypotheses about the effect of hearing a prior context sentence on immediate processing of a subsequent target sentence is described. According to the standard deep structure model, higher level processing (e.g. semantic interpretation, integration of context-target information) does not occur immediately as speech is heard but is delayed until an initial deep structure analysis has been conducted. In contrast, the "on-line interactive" view states that processing proceeds at all levels simultaneously, implying that presence/absence of prior context should affect immediate processing. Two experiments confirm that context has a significant effect on immediate structural (syntactic/semantic) and lexical processing, supporting the on-line interactive view. A newly-developed on-line, short-latency sentence continuation task measured changes in the complexity of structural processing, while word monitoring latency provided an index of lexical processing. Results also supported a number of new hypotheses one of which stated that context can have opposite effects on immediate structural and lexical processing. While the addition of a prior context sentence always facilitated lexical processing, it either increased or decreased the complexity of structural processing at different points in the sentence depending on whether incoming material contained "old" or "new" information in relation to the context sentence. (Author/AMH)

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OPPOSITE EFFECTS OF CONTEXT ON IMMEDIATE STRUCTURAL AND LEXICAL PROCESSING[1]

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This paper is concerned with the issue of whether hearing a prior context sentence, affects immediate or "on-line" processing of a subsequent target sentence. There are two views on the role of context. One is associated with Fodor, Bever & Garrett, who claim that immediate processing of sentences involves the recovery of deep structure. This means that higher level decisions including semantic decisions must be delayed. It also implies that the integration of prior context sentence information does not take place on-line. In fact, Hurtig explicitly claims that prior context sentence information is integrated only when the target sentence has been stored in memory. Now the contrasting on-line interactive view (associated with Marslen-Wilson) is that immediate processing proceeds at all linguistic levels simultaneously and that the results of earlier processing guide and constrain later processing. This alternate view may be taken to imply that prior context information is integrated immediately and that context guides and constrains immediate processing of subsequent sentences.

The two experiments described here examine the effect of context on both immediate structural and lexical processing. By lexical processing I mean simply, word recognition. Structural processing refers to both syntactic and semantic aspects of analysis. The hypothesis tested here, then, is that

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[1] Paper read at the Annual Meeting of the Linguistic Society of America, Boston, December 1978.

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context does affect immediate structural and lexical processing and that these effects will sometimes be in opposite directions. Specifically, the expectation is that context will always facilitate word recognition while the very same context will sometimes increase the complexity of structural processing and at other times will reduce the complexity of structural processing. Whether processing complexity is increased or reduced at a particular point, depends on whether the information being encountered at that moment is old or new in relation to the context sentence.

Before I try to develop this argument it may be useful for you to look at the sample experimental sentences on page one of your handout. You will see that there are two types of context material and four types of target sentence. All 72 sets of sentences used in the experiments were very similar to this set, except that the people and events described were changed. One of the two context types is a normal relevant sentence. The other is an irrelevant sentence in which the word order has been scrambled. The latter represents a "no-context" situation and simply provides a standard of comparison against which the effect of adding normal relevant context can be judged. Looking at the target sentences now, you will see that each one contains both "old" and "new" information in relation to the normal context sentence. For example, the first clause of Sentence 3, the words "*what annoys him*," restates old information which occurs in the normal context sentence in the form "*the boss has been displeased.*" In two types of target sentence, that is (3) and (4), the old information occurs early in the sentence while in the other two types, that is (5) and (6), it occurs late. It should be mentioned in passing that the form of these context and target sentences was determined by a number of other factors which I do not have time to discuss here.

The prediction is that in the normal context condition, the complexity of

structural processing has to increase at some point as new information clauses are processed. In the case of lexical processing the addition of a normal prior context sentence should only have a facilitating effect (or else have no effect), whether information being encountered is old or new. The crucial difference between the two types of processing in relation to context effects is that structural processing is essentially relational in character, and so, it cannot proceed without making constant reference to the developing partial representation of both context and target sentences. Word recognition, in contrast, need not necessarily involve any reference to previous material, even though word recognition is, in effect, usually facilitated by the constraints deriving from processing of earlier occurring material (within target sentences) (Marslen-Wilson). The addition of a normal prior context sentence, then, can only have the effect of facilitating lexical processing or leaving it unchanged. But the addition of the same normal context sentence must at some point increase the complexity of on-line structural processing, because of the increased number of components in the existing representation to which incoming new information must be related. If incoming information at a particular moment is old, that is, if it has already been encountered in some form in the context sentence, structural processing may instead be facilitated at that point in the target sentence. Thus, we predict that given that the target sentence contains some new information context will have opposite effects on immediate structural and lexical processing.

Method. To test these predictions, we needed separate measures of immediate structural and lexical processing. Word monitoring latency provided a straightforward measure of lexical processing. None of the existing on-line tasks, however, can be considered reasonably direct measures of structural processing and, consequently, none of them seemed likely to be sensitive to the kind of context effects we predicted. Previous studies using on-line linguistic tasks, such as word monitoring and speech shadowing, have indeed tried to

describe the progress of structural processing. But they have done this in an indirect fashion, by examining and making inferences from, changes in the number of constraints on lexical processing. In the present study we are trying to measure changes in the complexity of structural processing itself – not just changes in the state of on-line representation being constructed, or consequential changes in the number of constraints on lexical processing. Thus, we needed an on-line task which was sensitive to structural rather than lexical processing. The measure developed was a modified, short-latency version of the familiar *sentence fragment completion* task. In this on-line version, subjects hear a fragment, at the end of which signal lights are activated. Their task is to generate a one-word appropriate continuation as quickly as possible and, then, without time pressure, to produce a completion for the sentence which incorporates the one-word continuation. Latency to initiate continuations is, on average, between 600 and 700 msec for the sentences in these experiments.

I cannot go into very much detail about the various arguments for considering sentence continuation latency as a measure of structural processing. It may be noted at least, however, that in this task subjects have to generate the appropriate continuation word themselves, so that they cannot prepare and initiate a response, until material up to the last word heard, has been fully analysed at syntactic and semantic levels. In contrast, responses on the various lexically based monitoring and shadowing tasks can be made without necessarily waiting for the completion of syntactic and semantic analysis. Consequently, response latencies on these latter tasks are unlikely to directly reflect fluctuations in the complexity of structural processing. There is independent evidence, also, that completion-type tasks, similar to the sentence continuation one used here, measure structural rather than lexical processing. Studies by Bever, Garrett & Hurtig and Cairns & Kamerman show that sentence completion is sensitive to structural ambiguity but not to lexical ambiguity.

Lastly, we come to the position factor, that is, the various positions in the sentence at which processing activity is measured. There are six levels of position, corresponding to the first six words of the target sentence. The last word-position is not considered. Thus, for example, *position 3* refers to a situation where the subject hears the first three words of the target sentence before receiving a signal to provide a continuation. At the corresponding *position 3* in word monitoring the prespecified target word is the third word of the sentence.

The two experiments, of course, involved exactly the same linguistic materials but different processing tasks – word monitoring and sentence continuation. In both experiments subjects were presented with only one of the eight possible context-target combinations from each of the 72 sets, to avoid the problem of their becoming familiar with the materials. Subjects also heard practice and filler sentences. A different group of 24 male and female University of Chicago students took part in each experiment, making a total of 48 subjects in all.

Results. I should first mention here that an increase in sentence continuation latency is taken as evidence for an increase in the complexity of structural processing. And a decrease in latency is assumed to reflect a reduction in the complexity of processing. Note also, that I am talking here about the complexity of structural processing which is not necessarily the same as some index of structural complexity.

In Table 1 you will see that while context reduces word monitoring latency overall, it increases sentence continuation latency. This fact was also reflected in a significant *context x task* interaction in an analysis of variance – where *task* referred to word monitoring or sentence continuation. Looking at Figures 1-4 now you will see that at some positions sentence continuation latency is reduced by the addition of a normal prior context sentence – in other words the overall direction of the context effect for

sentence continuation is reversed at some positions. These reversals occur in what I have called old information clauses. This result is reflected in a number of ways in the various statistical analyses I conducted. For example, in an analysis of variance of the sentence continuation latencies alone, the interaction *context* x *position* x *target type* was significant. I interpreted this interaction as being due to the fact that old information clauses, and hence reversals, occurred early in two target types and later in the other two. To check this interpretation I conducted a planned comparison of mean sentence continuation latencies for all old information clauses and for all new information clauses. When I tested the difference between these means under the irrelevant context condition the result was not significant, since, of course, the old/new distinction could not be relevant when prior context is irrelevant. Not surprisingly, also, a similar test under the normal context condition showed that old information clauses have significantly shorter mean sentence continuation latencies than have new information clauses.

To summarise, then: Normal prior context sentences affect immediate structural and lexical processing of subsequent target sentences. At a given position context either facilitates or leaves unchanged lexical processing. Structural processing may either increase or decrease in complexity at corresponding positions depending on whether incoming information is old or new. Finally, and more generally, these results appear to be incompatible with any model of speech perception which proposes that higher level semantic and contextual analysis is delayed until a deep structure analysis is complete.

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Opposite effects of context on immediate structural and lexical processing.

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Context Sentence

Normal (1) The boss has been displeased since employing the plumbers.

Irrelevant (2) Valley in needed the to land badly rain this irrigate is.

Target Sentence

Pseudo-cleft (3) What annoys him is their wasting time.

Passive (4) He is annoyed by their wasting time.

Conjunction (5) They waste time and that annoys him.

Reverse Pseudo-cleft (6) Their wasting time is what annoys him.

Tasks: (a) Sentence continuation latency: Measures structural processing.

Example:
The boss has been displeased since employing the plumbers.
They waste
<<LATENCY>>(PROVIDE ONE WORD CONTINUATION...THEN A COMPLETION)

(b) Word monitoring latency: Measures lexical processing (word recognition).

Example:
Prespecified target word: "waste"

The boss has been displeased since employing the plumbers.
They waste time and that annoys him.
<<LATENCY>>(PRESS RESPONSE KEY)

Some Results

TABLE 1

Mean Latency in Msec according to Task, Context, and Position

	CONTEXT	POSITION						ALL POSITIONS
		1	2	3	4	5	6	
WORD MONITORING	NORMAL	359	381	321	288	255	336	323
	IRRELEVANT	416	438	340	298	273	341	351
SENTENCE CONTINUATION	NORMAL	732	692	590	632	745	556	658
	IRRELEVANT	701	655	570	605	704	555	632

(OVER)

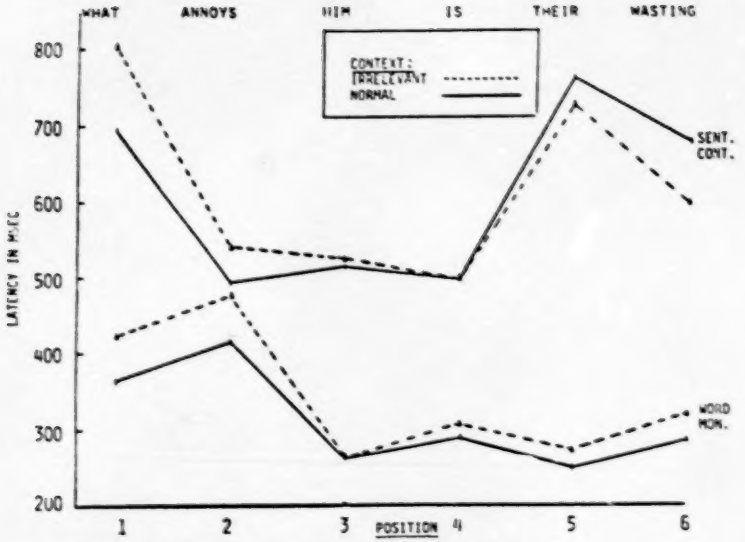

Fig. 1 MEAN LATENCY AT EACH POSITION FOR PSEUDO CLEFT

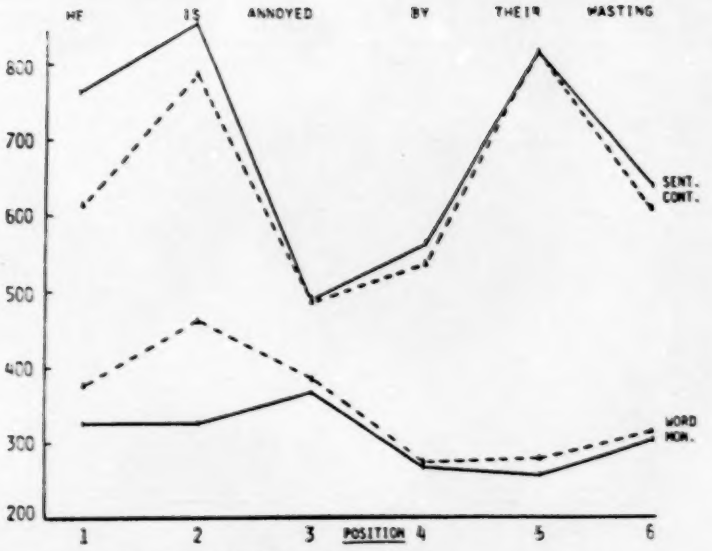

Fig. 2 MEAN LATENCY AT EACH POSITION FOR PASSIVE

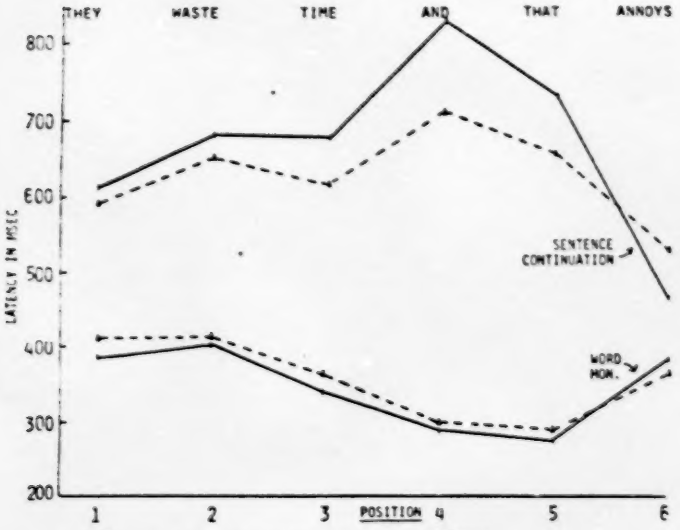

Fig. 3 MEAN LATENCY AT EACH POSITION FOR 'CONJUNCTION'

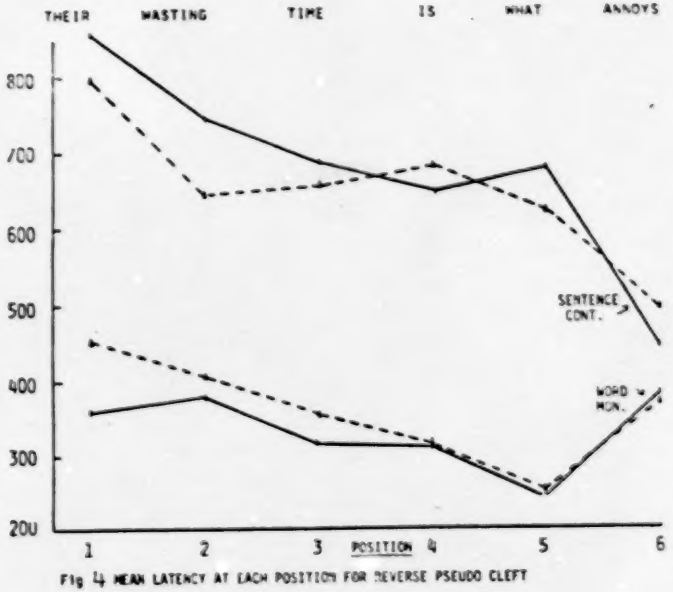

Fig 4 MEAN LATENCY AT EACH POSITION FOR REVERSE PSEUDO CLEFT